GENERALIZED MONOTONE FINITE DIFFERENCE METHODS FOR APPROXIMATING VISCOSITY SOLUTIONS

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Abstract. We will discuss a new framework for designing and analyzing finite difference (FD) methods for approximating both classical and viscosity solutions of fully nonlinear partial differential equations (PDEs). The main emphasis of the talk will be on second order equations and the use of multiple derivative and Hessian approximations to capture the behavior of low-regularity functions at local extrema. The key concept for the new framework is generalized monotonicity, a property that is often easier to realize in practice than traditional concepts of monotonicity. By using a higher-order generalized monotonicity approach, narrow-stencil schemes are proposed that are based on stabilization techniques motivated by the vanishing moment method for indirectly approximating second order fully nonlinear PDEs with fourth order quasilinear PDEs. Numerical tests based on the Hamilton-Jacobi-Bellman equation and the Monge-Ampère equation are presented to gauge the performance of the proposed finite different methods and to validate the theoretical foundation of the framework. This talk is based upon a joint work with Xiaobing Feng (UT).